Intelligent Roads (INTRO)

EU - FP6

“A Vision of Intelligent Roads”

Workshop on Intelligent Highways – expectation and requirements

25th October, 2007 – Brussels

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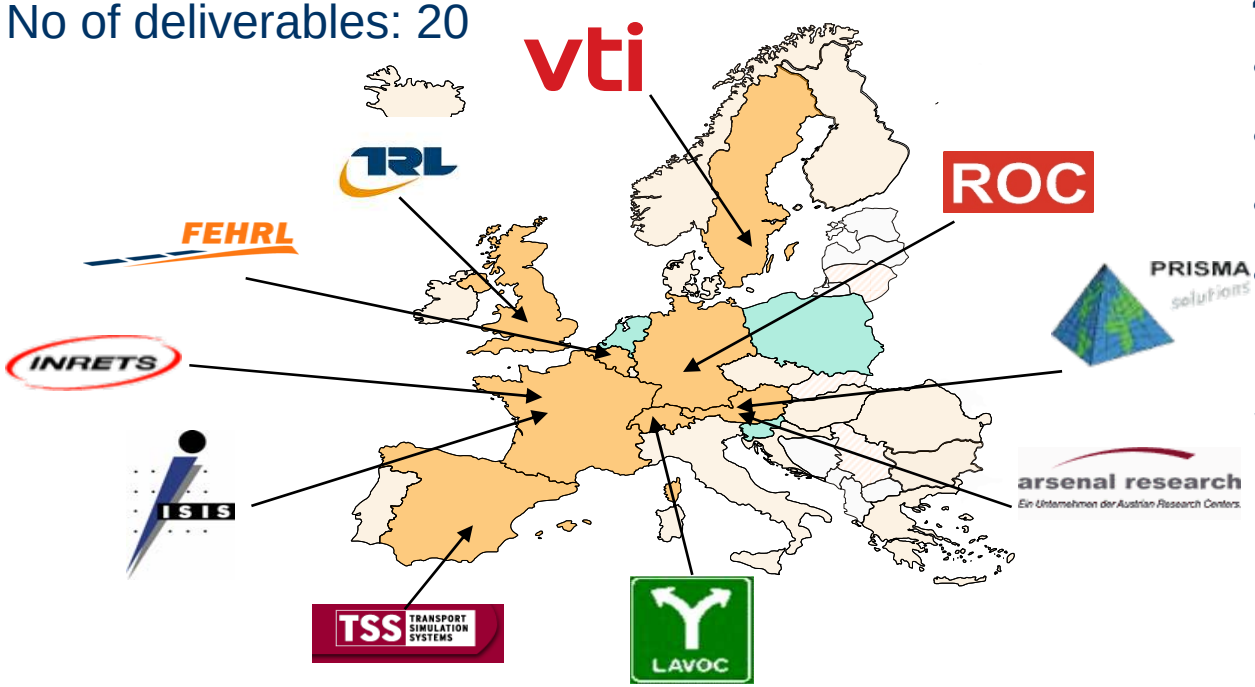
Project figures

- Total budget: 3.50 M€
- Community contribution: 1.99 M€
- Start date: March 1:st 2005
- Duration: 36 months
- No of partners: 10
- Person months: 284
- No of deliverables: 20



Consortium

6 Research partners:

- VTI (SE) (Coordinator)
- Arsenal Research (AT)
- FEHRL (EU)
- INRETS (FR)
- EPFL-LAVOC (CH)
- TRL (UK)

4 Industrial partners:

- ISIS (FR)
- Prisma Solutions (AT)
- ROC (GE)
- TSS (ES)

5 FEHRL partners:

IBDiM (PL), ZAG(SI), DWW (NL), LCPC (FR), BRRC (B)

INTRO Objectives

- **WP2 Novel methods of surface safety monitoring**
  - decrease the number of skid accidents caused by "surprise effects"
- **WP3 Pavement conditions from intelligent pavement and intelligent vehicles**
  - extend lifetime of high capacity roads,
  - improve usability of low volume roads
- **WP4 Traffic and safety monitoring**
  - increase traffic flow,
  - decrease journey times,
  - prevent accidents, e.g. rear end collisions
- **WP5 Clustering and dissemination of results**
  - integrate results and shape current and emerging practices at a pan-European level

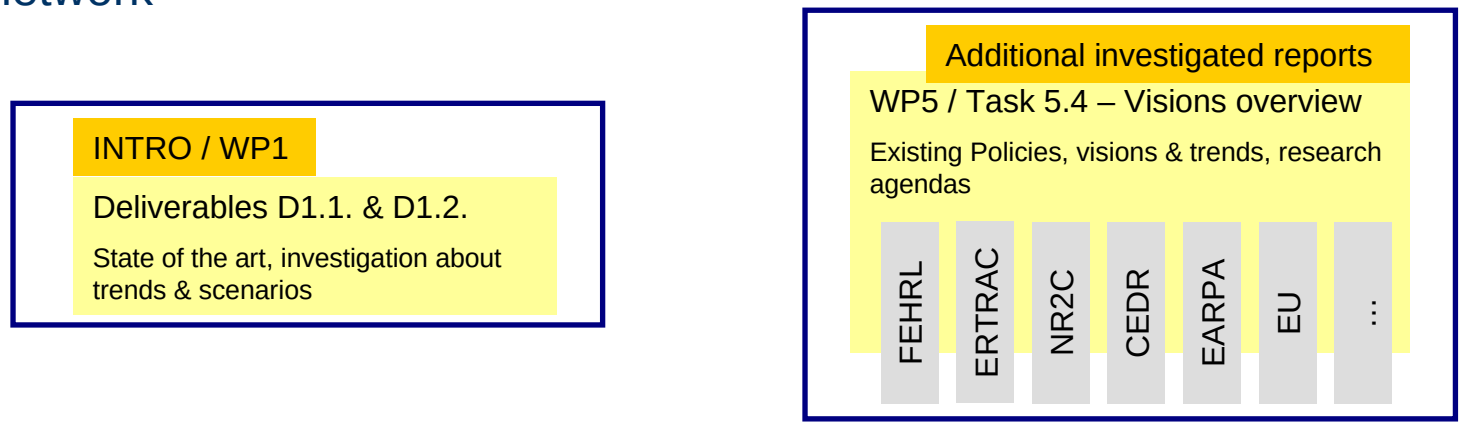
Task 5.4: A Vision of Intelligent Roads

Development of a range of concrete scenarios and visions on intelligent roads

Consolidated overview of the visions of the future with respect to use of the road transport systems and with specific relevance to Intelligent Roads

Methodology

→ Illustrate how the "intelligence" of the road could evolve, by referring to already existing policies, strategies or visions for mobility, transport and more particularly road network



→ Refer to the INTRO WP leaders and partners, in order to focus the vision more on the INTRO research strand

(existing) Visions overview (1)

Key findings:

Background and Basic requirements

- ***Socio-economic constraints***: *EU enlargement, growing and ageing population, lifestyle changes, changes in production processes, open market, Just In Time, resources (material) access, land planning…*

- ***Road use constraints:*** *fuel costs, safety, congested roads, road lifecycle, travel cost, travel time, travel shift…*

- ***Environmental constraints***: *CO2 & other emissions, noise, climate change, prime materials limitation...*

- ***Technological and innovation pressure****: increased use of electronics, new sensors & applications, ICT development, service providers…*

- ***Users needs and expectations****: SMART Travel (time, cost, behaviour), SAFE Travel, CLEAN Travel, COMFORTABLE Travel, RELIABLE Travel, Availability of ACCESS, Suitability of road FUNCTION; additionally, road network needs to be multifunctional*

Background & basic requirements – Synthesis from investigation about trends, visions & scenarios

(existing) Visions overview (2)

Key findings:

Scenarios

• ***EU policies*** : Transport : co-modality, shift to the most environmentally friendly mode where appropriate for an optimal and sustainable use of resources ; optimise transport modes and smart interfacing ; Environment : emission reduction … ; Safety ; Technology use ; Regulation framework ; European road network extension (eastern part)

• ***FURORE (automotive industry):*** smooth transition from the conventional to the new technologies will happen, no radical change is foreseen in the time period envisaged. Speed gradient function of political and economical boundaries and technical feasibility

• ***FEHRL*** : Given the time it takes to plan, design, and construct roads, much of the road network in twenty years time may not in fact differ greatly from that in use today ; however: strong economic and social forces at play → some substantial changes with likely bigger rolled-up effect than one might be tempted to expect

FEHRL believes that the actual future will be mainly characterised by a mixture of the three broad approaches between:
*2 extreme scenarios : **an ideal future supply-side** and **a do-nothing or do-minimum supply side***
*3 intermediate: **a government-driven scenario**, **a market-driven scenario** and **a sustainability-driven scenario**.*

Main developed scenarios – Synthesis from investigation

(existing) Visions overview (2)

Key findings:

Scenarios

• ***UK vision 2030*** *: 3 extreme scenarios (UK vision 2030) - "**Global economy**", a market-driven approach - "**Control, harmonise and plan**", a government-driven scenario - "**Sustainable lifestyle**", a community based way of living.*

• ***INTRO D1.2*** proposes *3 scenario-mixes reflecting the ways in which different parts of Europe are developing*:

- a "***Possible Eastern EU Mix***" - high involvement of private sector likely to happen ; however still with control and strict enforcement from public authorities,
- a "***Possible Nordic Mix***" - social & environmental considerations more important , however with a strong "Control, harmonise and plan" element, due to the importance attached to safety in the Nordic countries.
- The "***Optimised European Mix***" - places importance on sustainability issues but also with a high degree of control, planning and enforcement. Reduced role of the free-market as private financed infrastructure revert to the public sector after their concession period. More state intervention in order to promote modal shift, enforce environmental and safety regulations and, generally, ensure traffic flow.

Main developed scenarios – Synthesis from investigation

• Similarly ***NR2C*** develops *3 extreme social scenarios* to stimulate thinking about the future - ***a Public Authority-based scenario - a Market-based scenario - a Sustainable society scenario***.

INTRO - A 30 years Vision of Intelligent Roads (1)

Preliminary remarks

- One single vision cannot fit all types of networks (trans-European networks, urban highways, secondary strategic state roads, rural roads, mountainous roads, etc) and cannot fit all types of road system functions
- A key issue is the uneven development of ITS (in space, in time)
- The “who pays” issues remain crucial

→ A Vision should be pragmatic, based on prioritising applications and services for different road types (needs for intelligence; deployment business case)

INTRO - A 30 years Vision of Intelligent Roads (2)

Scenario proposed by INTRO - main issues

- In 30 years time the infrastructure will in many respects look like it does today.
- However, advent of a more technological road.
- Authorities will be forced to plan, harmonise, assess & control considerable changes.
- One of the preferred ways to deal with the increasing mobility needs today is to deploy more and more ITS.
- The majority of road users appeal for some changes.
- The market will make the best of these developments and will support innovation.

INTRO - A 30 years Vision of Intelligent Roads (2)

Scenario proposed by INTRO - main issues (con't)

• Emerging technologies will have the potential to improve the infrastructure's ability to measure, analyse, communicate, interact or furthermore to drive.

• Despite a more or less unchanged aspect, some visible modifications will take place, with a direct impact on our everyday life.

• Present and future communication means will lead to an explosion of wireless sensing and multidirectional interactions between vehicles and infrastructure.

INTRO - A 30 years Vision of Intelligent Roads (3)

The Vision proposed by INTRO – Road types and their operating environments

Road type	Physical characteristics	Location
UM -Urban Motorway-	2x3 lane motorway or expressway with hard shoulder (divided carriageways, grade-separated junctions)	Urban ring road
UR -Urban Road-	2+1 lane road (single carriageway, at-grade junctions with traffic signals)	Urban radial road
IM -Interurban Motorway-	2x2 lane motorway with hard shoulder (divided carriageways, grade-separated junctions)	Interurban – part of Trans-European road network in mountainous area, including tunnel and viaduct sections
IR -Interurban Road-	1+1 lane main road with hard shoulder on some sections (single carriageway, mostly at-grade junctions including roundabouts)	Interurban – part of Trans-European road network
RR -Rural Road-	1+1 lane secondary road with no hard shoulder	Rural – regional road in mountainous area linking ski resorts

Also characterised by:

- typical speed limit
- traffic and safety characteristics
- weather and environmental characteristics

INTRO - A 30 years Vision of Intelligent Roads (3)

The Vision proposed by INTRO – Major functional concerns

- Safety Issues,
- User Services,
- Infrastructure Sustainability,
- Transport and Traffic Capacity,
- Global Issues including environment, economy and social aspects

Prioritisation of solutions

Required	Req.
Recommended	Rec.

INTRO - A 30 years Vision of Intelligent Roads (3)

Emerging Vision Items – On the European urban motorways

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Safety Issues					
Dynamic and Interactive road infrastructure					
Optimised & Dynamic road geometry					
Forgiving road					
Dynamic & interactive signing	X				
Traffic monitoring	X				
Surface & road condition monitoring	X				
Incident management	X				
Infrastructure/vehicle interaction to support:					
Hot spots & Pre-crash warning	X				
ADAS	X				
In-vehicle control	X				
Violation control & prevention measures					
Enforcement measures on single spots	X				
Dynamic automated enforcement, in vehicle control, section & network control systems	X				
Long range tracking and tracing of traffic and driving behaviour	X				

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
User Services					
Infrastructure based systems to support:					
Pre-Trip information	X				
Real time, on-trip information	X				
Mobile services & Nomadic devices					
Plugged users					
Ad-hoc Network & V2V Communication	X				
Infrastructure based services and information					
Roadside communication infrastructure	X				
Multimodal interfaces	X				
Dedicated Freight Services	X				
Payment services & Tolling support	X				

Road type code	UM	UR	IM	IR	RR
Sustainable infrastructure					
Intelligent Lifecycle management					
Optimised pavement monitoring	X				
Enhanced modelling of road and bridge infrastructures	X				
Lifecycle optimisation strategies	X				
Optimised targeted repair	X				
Self sufficient and self controlling Road					
Automated load control, access, enforcement	X				
Dynamic (light) lane marking	X				
Self repairing pavement layers					
Self protecting roads and bridges	X				
Self supplying & Intelligent Road lighting					
Automated self winter services					
Environment and energy compliant Road					
Environmental monitoring	X				
Environmental dynamic measures & enforcement	X				
Environmentally-driven management					
Environmental monitoring for dynamic access and flow control	X				
Consumption reduction schemes	X				

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Capacity (transport & traffic)					
Traffic Tracking & Tracing					
Airborne & satellite traffic monitoring					
Area Tracking and tracing (3D video)	X				
Demand and (dynamic) Capacity management					
Dynamic Road Access Management	X				
Cybernetic traffic control	X				
Active Traffic Management	X				
ITS/ VMS systems	X				
Variable lane configuration & Dynamic lane allocation	X				
Cooperative and automated driving					
Cooperative (I2V & V2V) driving					

INTRO - A 30 years Vision of Intelligent Roads (3)

Emerging Vision Items – On the Urban radial roads

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Safety Issues					
Dynamic and Interactive road infrastructure					
Optimised & Dynamic road geometry					
Forgiving road					
Dynamic & interactive signing	X	X			
Traffic monitoring	X	X			
Surface & road condition monitoring	X				
Incident management	X				
Infrastructure/vehicle interaction to support:					
Hot spots & Pre-crash warning	X	X			
ADAS	X	X			
In-vehicle control	X	X			
Violation control & prevention measures					
Enforcement measures on single spots	X	X			
Dynamic automated enforcement, in vehicle control, section & network control systems	X				
Long range tracking and tracing of traffic and driving behaviour	X				

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
User Services					
Infrastructure based systems to support:					
Pre-Trip information	X	X			
Real time, on-trip information	X				
Mobile services & Nomadic devices					
Plugged users					
Ad-hoc Network & V2V Communication	X				
Infrastructure based services and information					
Roadside communication infrastructure	X	X			
Multimodal interfaces	X	X			
Dedicated Freight Services	X	X			
Payment services & Tolling support	X				

Road type code	UM	UR	IM	IR	RR
Sustainable infrastructure					
Intelligent Lifecycle management					
Optimised pavement monitoring	X				
Enhanced modelling of road and bridge infrastructures	X				
Lifecycle optimisation strategies	X	X			
Optimised targeted repair	X	X			
Self sufficient and self controlling Road					
Automated load control, access, enforcement	X	X			
Dynamic (light) lane marking	X				
Self repairing pavement layers					
Self protecting roads and bridges	X				
Self supplying & Intelligent Road lighting					
Automated self winter services					
Environment and energy compliant Road					
Environmental monitoring	X	X			
Environmental dynamic measures & enforcement	X	X			
Environmentally-driven management					
Environmental monitoring for dynamic access and flow control	X	X			
Consumption reduction schemes	X	X			

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Capacity (transport & traffic)					
Traffic Tracking & Tracing					
Airborne & satellite traffic monitoring					
Area Tracking and tracing (3D video)	X				
Demand and (dynamic) Capacity management					
Dynamic Road Access Management	X	X			
Cybernetic traffic control	X				
Active Traffic Management	X	X			
ITS/ VMS systems	X	X			
Variable lane configuration & Dynamic lane allocation	X				
Cooperative and automated driving					
Cooperative (I2V & V2V) driving		X			

INTRO - A 30 years Vision of Intelligent Roads (3)

Emerging Vision Items – On the Interurban motorways

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Safety Issues					
Dynamic and Interactive road infrastructure					
Optimised & Dynamic road geometry			X		
Forgiving road			X		
Dynamic & interactive signing	X	X	X		
Traffic monitoring	X	X	X		
Surface & road condition monitoring	X		X		
Incident management	X		X		
Infrastructure/vehicle interaction to support:					
Hot spots & Pre-crash warning	X	X	X		
ADAS	X	X	X		
In-vehicle control	X	X	X		
Violation control & prevention measures					
Enforcement measures on single spots	X	X	X		
Dynamic automated enforcement, in vehicle control, section & network control systems	X		X		
Long range tracking and tracing of traffic and driving behaviour	X		X		

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
User Services					
Infrastructure based systems to support:					
Pre-Trip information	X	X	X		
Real time, on-trip information	X		X		
Mobile services & Nomadic devices			X		
Plugged users			X		
Ad-hoc Network & V2V Communication	X		X		
Infrastructure based services and information					
Roadside communication infrastructure	X	X	X		
Multimodal interfaces	X	X			
Dedicated Freight Services	X	X	X		
Payment services & Tolling support	X		X		

Road type code	UM	UR	IM	IR	RR
Sustainable infrastructure					
Intelligent Lifecycle management					
Optimised pavement monitoring	X		X		
Enhanced modelling of road and bridge infrastructures	X		X		
Lifecycle optimisation strategies	X	X	X		
Optimised targeted repair	X	X	X		
Self sufficient and self controlling Road					
Automated load control, access, enforcement	X	X			
Dynamic (light) lane marking	X		X		
Self repairing pavement layers			X		
Self protecting roads and bridges	X		X		
Self supplying & Intelligent Road lighting			X		
Automated self winter services			X		
Environment and energy compliant Road					
Environmental monitoring	X	X	X		
Environmental dynamic measures & enforcement	X	X			
Environmentally-driven management					
Environmental monitoring for dynamic access and flow control	X	X	X		
Consumption reduction schemes	X	X			

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Capacity (transport & traffic)					
Traffic Tracking & Tracing					
Airborne & satellite traffic monitoring			X		
Area Tracking and tracing (3D video)	X				
Demand and (dynamic) Capacity management					
Dynamic Road Access Management	X	X	X		
Cybernetic traffic control	X		X		
Active Traffic Management	X	X	X		
ITS/ VMS systems	X	X	X		
Variable lane configuration & Dynamic lane allocation	X		X		
Cooperative and automated driving					
Cooperative (I2V & V2V) driving		X	X		

INTRO - A 30 years Vision of Intelligent Roads (3)

Emerging Vision Items – On the Interurban roads

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Safety Issues					
Dynamic and Interactive road infrastructure					
Optimised & Dynamic road geometry			X		
Forgiving road			X		
Dynamic & interactive signing	X	X	X	X	
Traffic monitoring	X	X	X	X	
Surface & road condition monitoring	X		X	X	
Incident management	X		X		
Infrastructure/vehicle interaction to support:					
Hot spots & Pre-crash warning	X	X	X	X	
ADAS	X	X	X		
In-vehicle control	X	X	X		
Violation control & prevention measures					
Enforcement measures on single spots	X	X	X	X	
Dynamic automated enforcement, in vehicle control, section & network control systems	X		X	X	
Long range tracking and tracing of traffic and driving behaviour	X		X		

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
User Services					
Infrastructure based systems to support:					
Pre-Trip information	X	X	X	X	
Real time, on-trip information	X		X		
Mobile services & Nomadic devices			X	X	
Plugged users			X		
Ad-hoc Network & V2V Communication	X		X	X	
Infrastructure based services and information					
Roadside communication infrastructure	X	X	X	X	
Multimodal interfaces	X	X			
Dedicated Freight Services	X	X	X		
Payment services & Tolling support	X		X		

Road type code	UM	UR	IM	IR	RR
Sustainable infrastructure					
Intelligent Lifecycle management					
Optimised pavement monitoring	X		X	X	
Enhanced modelling of road and bridge infrastructures	X		X	X	
Lifecycle optimisation strategies	X	X	X	X	
Optimised targeted repair	X	X	X	X	
Self sufficient and self controlling Road					
Automated load control, access, enforcement	X	X			
Dynamic (light) lane marking	X		X	X	
Self repairing pavement layers			X		
Self protecting roads and bridges	X		X	X	
Self supplying & Intelligent Road lighting			X	X	
Automated self winter services			X		
Environment and energy compliant Road					
Environmental monitoring	X	X	X		
Environmental dynamic measures & enforcement	X	X			
Environmentally-driven management					
Environmental monitoring for dynamic access and flow control	X	X	X		
Consumption reduction schemes	X	X			

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Capacity (transport & traffic)					
Traffic Tracking & Tracing					
Airborne & satellite traffic monitoring			X		
Area Tracking and tracing (3D video)	X				
Demand and (dynamic) Capacity management					
Dynamic Road Access Management	X	X	X		
Cybernetic traffic control	X		X		
Active Traffic Management	X	X	X	X	
ITS/ VMS systems	X	X	X	X	
Variable lane configuration & Dynamic lane allocation	X		X		
Cooperative and automated driving					
Cooperative (I2V & V2V) driving		X	X		

INTRO - A 30 years Vision of Intelligent Roads (3)

Emerging Vision Items – On the Rural roads

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
Safety Issues					
Dynamic and Interactive road infrastructure					
Optimised & Dynamic road geometry			X		
Forgiving road			X		
Dynamic & interactive signing	X	X	X	X	X
Traffic monitoring	X	X	X	X	
Surface & road condition monitoring	X		X	X	
Incident management	X		X		
Infrastructure/vehicle interaction to support:					
Hot spots & Pre-crash warning	X	X	X	X	
ADAS	X	X	X		
In-vehicle control	X	X	X		
Violation control & prevention measures					
Enforcement measures on single spots	X	X	X	X	
Dynamic automated enforcement, in vehicle control, section & network control systems	X		X	X	
Long range tracking and tracing of traffic and driving behaviour	X		X		

Road type code	Urban Motorway	Urban Road	Interurban Motorway	Interurban Road	Rural Road
User Services					
Infrastructure based systems to support:					
Pre-Trip information	X	X	X	X	
Real time, on-trip information	X		X		
Mobile services & Nomadic devices			X	X	X
Plugged users			X		
Ad-hoc Network & V2V Communication	X		X	X	
Infrastructure based services and information					
Roadside communication infrastructure	X	X	X	X	
Multimodal interfaces	X	X			
Dedicated Freight Services	X	X	X		
Payment services & Tolling support	X		X		

Road type code	UM	UR	IM	IR	RR
Sustainable infrastructure					
Intelligent Lifecycle management					
Optimised pavement monitoring	X		X	X	X
Enhanced modelling of road and bridge infrastructures	X		X	X	
Lifecycle optimisation strategies	X	X	X	X	
Optimised targeted repair	X	X	X	X	
Self sufficient and self controlling Road					
Automated load control, access, enforcement	X	X			
Dynamic (light) lane marking	X		X	X	
Self repairing pavement layers			X		
Self protecting roads and bridges	X		X	X	
Self supplying & Intelligent Road lighting			X	X	
Automated self winter services			X		X
Environment and energy compliant Road					
Environmental monitoring	X	X	X		
Environmental dynamic measures & enforcement	X	X			
Environmentally-driven management					
Environmental monitoring for dynamic access and flow control	X	X	X		
Consumption reduction schemes	X	X			

Stakeholders consultation

On the one hand:

Assess the relevance of the different vision facets presented in this session

On the other hand:

Scale these developments in time

Through a dedicated Web-Questionnaire ….. Very soon in your mailbox

Thanks for your kind attention

Xavier Cocu, FEHRL/BRRC